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NASA TECH BRIEF

Fiberglass-Reinforced Structural Materials for Aerospace Application

An extensive investigation has been conducted to evaluate fiberglass-reinforced plastic materials for application in aerospace structures. These materials are of particular interest for such applications because of their low density, unidirectional strength, low thermal conductivity, and fabricability. Possibly the greatest potential of the materials is in their proposed use as tension supports for cryogenic tanks.

The investigation was carried out along four lines: These were: (1) a literature survey; (2) conceptual design, detail design, and analysis; (3) development of a manufacturing plan, identification of process controls, and fabrication of parts; and (4) preparation of a test plan, testing, and analysis of results.

The literature review resulted in the selection of composite materials and adhesives that could be expected to have the best characteristics at ambient and cryogenic temperatures. Epoxy resins and fiberglass reinforcements were the materials chosen for experimental evaluation. The specific structural elements investigated were tension rods, tubular struts, and I beams. Comparisons were made with their metallic counterparts to determine the thermal and weight advantages of using fiberglass-reinforced plastic structures. The tension rods and tubular struts were considered for cryogenic tank supports, and were compared with similar members made from low-thermal conductivity alloys. The beams were conceived as payload support members where light weight, rather than low thermal conductivity was of primary concern.

It is concluded from the investigation that fiberglass construction offers some weight saving when compared with aluminum alloy construction in the case of beams and struts. A greater potential of the fiberglass material is realized in cryogenic tank supports, as the result of its low thermal conductivity and strength. Deflections are greater and stiffness is less than for comparable metallic parts. Therefore in cases where stiffness design criteria prevail and thermal conductivity is not a factor, advanced composites employing filamentary materials of boron or carbon are believed to be more competitive with metallic materials.

Note:

Complete details may be obtained from:
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No patent action is contemplated by NASA.

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